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Impact of Water Hyacinth (*Eichhornia Crassipes*) on Physico-Chemical Properties of Water, Phytoplankton Biomass and Nile Tilapia Production in Earthen Ponds

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ABSTRACT

The effect of free-floating plant, water hyacinth (*Eichhornia crassipes*) cover on water physico-chemistry, phytoplankton biomass and abundance, and fish production in earthen fish ponds was evaluated. Waterhyacinth cover of 0, 5 and 10% surface area was established in earthen ponds stocked with Nile tilapia, *Oreochromis niloticus*, at Abbassa fish farm, Sharkia governorate. There were no significant differences in water temperature, turbidity, conductivity, total ammonia, nitrite, and orthophosphate among the different treatments. PH-value, dissolved oxygen, carbonate alkalinity and concentrations of nitrate in control and T1 were significantly higher than those of T2. Phytoplankton production was less in ponds with 5 and 10% cover than in ponds without (control) water hyacinth. Concentrations of dissolved oxygen were lowest in ponds with 10% cover, but oxygen tensions in all ponds were adequate for survival and growth of fish. The presence of 5 and 10 % waterhycinth cover did not significantly affect phytoplankton abundance and composition as well as fish production.

Keywords: **water hyacinth, water properties, phytoplankton, fish ponds.**

INTRODUCTION

The high feeding levels necessary to sustain semi-intensive and intensive fish culture systems contribute large amounts of nutrients in the pond water. These nutrients are available to the phytoplankton and enhance their proliferation (Boyd and Tucker, 1998). However, without algal biomass control, an excessive algal bloom may occur followed by a collapse of the algal population, an increase in ammonia concentration, and oxygen depletion which adversely affects the water quality and fish production in ponds (Lovell 1983; Gilles et al., 2013). Thus, intermediate densities of phytoplankton should be developed, because this has shown a greater potential to produce higher dissolved oxygen concentration (Smith and Piedrahita 1988). The vascular floating aquatic plant water hyacinth (*Eichhornia crassipes*) has shown to absorb high levels of nitrogen and phosphorus (Ferdoushi et al., 2008) and has been compete with the phytoplankton to control its densities (McVea and Boyd 1975; Costa-Pierce *et al*. 1985; Velasco and Cortes, 1994).

The presence of water hyacinth may enhance water quality due to their ability to absorb excessive loads of nutrients. Also, plants can assimilate ammonia that is excreted by fish thereby helping to prevent accumulation of potentially toxic concentrations of ammonia. Plants affect environmental conditions of water by resistance of mixing and gradients in dissolved oxygen (DO), pH and temperature form in and around plant beds. Water hyacinth mats are evidently important for various macro-invertebrates that live on plant leaves (e.g. snails and arachnids). The most important function of the hyacinth mats seems to be a sheltering or nursery function for small size classes of fish (Rommens et al. 2003).

However, excessive growth of these plants can cause detrimental effects and may affect water quality, density and diversity of phytoplankton to management options that no benefit fish and fishing (Joseph and Richard, 2006) and control measures often must be used to eliminate or reduce their abundance.

No sufficient information is available about the effect of water hyacinth in earthen ponds receiving dry feeds. So, the objective of this work is to describe the effect of this common free floating macrophyte on water physico-chemical properties, phytoplankton structure and densities as well as fish production in earthen ponds receiving artificial feeds.

MATERIALS AND METHODS

The investigation was conducted at a private farm located at the Central Laboratory for Aquaculture Research, Abbassa, Abo-Hammad, Sharqia, Egypt from June 2012 to January 2013. Nine earthen ponds with an average area of one feddan each were used and represented three treatments. The ponds were covered at about 0, 5 and 10 % of their area with water hyacinths. The water hyacinths were entered with the feeding water or taken manually in the ponds as required to maintain the percentage cover. Plants were anchored by a rope placed at the two banks of each pond. The ponds averaged 1.5 m in depth. Water was supplied to the ponds through Gadoan canal (a branch of Ismailia canal). Tilapia fingerlings (*Oreochromis niloticus*) with an average weight 15 g, were stocked at a density of 4 fish/m^2. The fish were fed with a commercially available sinking pellet (25% crude protein) daily. The initial feeding rate was 5% of body weight, this percentage decreased with increasing fish weight to 3% of fish weight after two months and 2% of the body weight after four months. At the end of the experiment, the ponds were drained and fish were removed, counted, and weighed.

Sampling

Water samples collected monthly from different places at each pond by a vertical PVC tube column sampler at depth of half meter from the water surface. The samples at each pond were mixed in a plastic bucket and a sample of 1 liter was placed in a polyethylene bottle and transferred cold to the laboratory for analysis. A water sample (1 liter bottle) was also collected for phytoplankton determination and preserved with Lugol's solution.

Laboratory analysis

Hydrogen ion concentration (pH) was measured with pH meter (Model 25, Fisher Scientific). Total dissolved solids (TDS) were determined using a salinity-conductivity meter (model, YSI EC 300). Dissolved oxygen was measured by using a digital oxygen meter (Model YSI 55). The concentrations of carbonate and bicarbonate alkalinity (mg l^{-1} as $CaCO_3$), dissolved inorganic nitrogen (NH_3-N, NO_2-N and NO_3-N mg l^{-1}), dissolved phosphate (mg l^{-1}) and chlorophyll "a" (µg l^{-1}) were estimated according to Boyd and Tucker (1992). Transparency (cm) was measured by using a Secchi Disc of 20 cm diameter. Samples for phytoplankton estimation were allowed to settle in dark for one week and the supernatant was siphoned to reach 50 mL. The phytoplankton samples were identified to species according to Prescott (1961). The counts of phytoplankton were performed by using a Sedgwick-Rafter cell and a binocular microscope.

Statistical analysis

One-way ANOVA and Duncan multiple range test were used to evaluate the significant difference of the concentration of different items that were studied with respect to treatments.

Significant differences are stated at P<0.05 (Bailey, 1981).

RESULTS AND DISCUSSION

Water quality

The whole experimental period and monthly variations in water quality parameters are presented in Table (1) and Figs. (1, 2 and 3). The mean values of water temperature were decreased (21.98 ˚C) with increasing percentage cover (10%) with non-significant difference in all treatments (Figure 1). The maximum (30.33 ºC) and minimum (16.83 ºC) temperature degrees were obtained in control treatment during July and January, respectively. The variation in water temperature was related to differences in air temperature throughout the period of culture.

Table 1: ***Mean values (and ranges) of physico-chemical properties of pond water affected by water hyacinth cover during the experimental period.***

Parameters	Water hyacinth cover			P-value
	Control (0%)	T1 (5%)	T2 (10%)	
Temp. (ºC)	22.23 a (17.7-30.3)	21.91 a (16.83-28.3)	21.98 a (17.1-29.5)	0.6242
pH (unit)	9.07 a (8.63-9.35)	8.78 b (8.50-9.04)	8.64 b (8.35-8.89)	0.0215
D. Oxygen (mgl^{-1})	7.38 a (4.93-10.67)	5.49 b (4.37-6.83)	4.97 b (4.0-6.30)	0.0322
Carbonate (mgl^{-1})	19.99 a (5.3-34.3)	11.87 b (6.7-20.0)	9.39 c (2.1-18.5)	0.0034
Bicarbonate (mgl^{-1})	280.4 a (219.3-359.4)	323.4 a (248.5-393.5)	345.9 a (299.3-394.0)	0.0748
Total alk. (mgl^{-1})	300.4 a (248.5-369.5)	335.3 a (258.5-406.2)	355.3 a (315.3-402.4)	0.0645
Secchi disc (cm)	11.04 a (9.33-13.97)	11.79 a (9.0-16.33)	13.44 a (10.0-18.5)	0.3524
Total D. Salts (mgl^{-1})	345.7 a (237.7-417.7)	311.4 a (246.1-384.0)	293.8 b (207.0-296.5)	0.0458
Orthophosphate (mgl^{-1})	0.488 a (0.003-1.975)	0.427 a (0.006-1.424)	0.402 a (0.002-1.527)	0.4211
Total ammonia (mgl^{-1})	0.72 b (0.5-1.0)	0.83 b (0.7-1.03)	1. 03 a (0.7-1.30)	0.0294
Nitrite (mgl^{-1})	0.024 a (0.011-0.041)	0.028 a (0.010-0.055)	0.029 a (0.013-0.065)	0.0541
Nitrate (mgl^{-1})	0.439 a (0.326-0.727)	0.378 a (0.187-0.510)	0.251 b (0.160-0.349)	0.0365

Means with the different litter in the same raw are significantly different at P < 0.05.

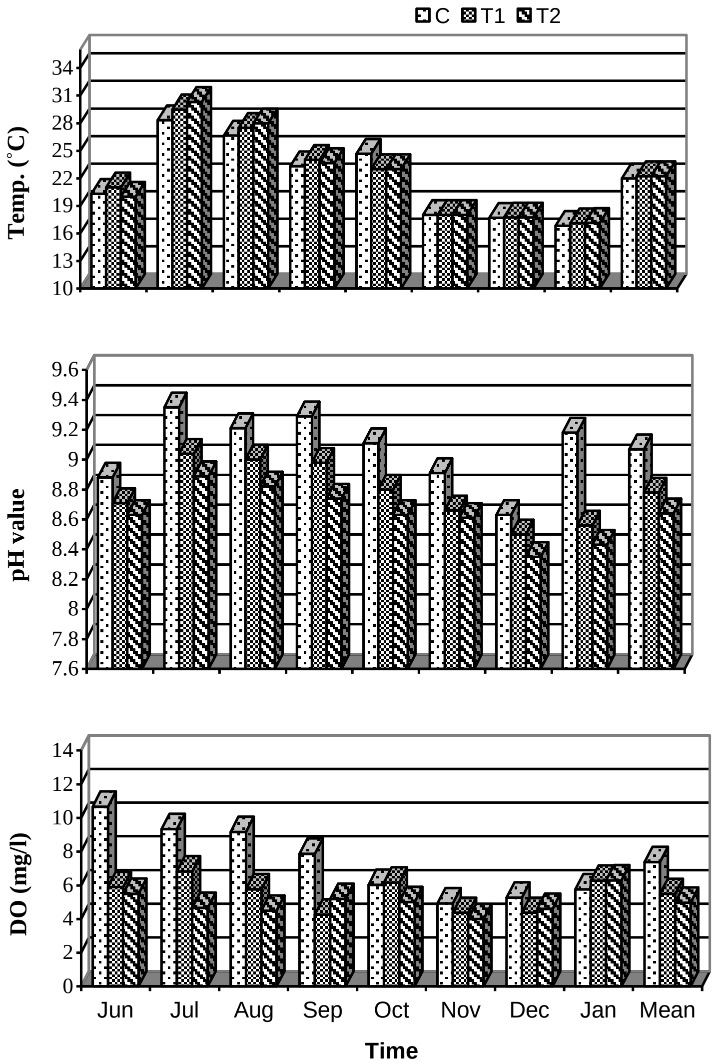

Figure 1: Monthly variations of water temperature (˚C), pH and dissolved oxygen in earthen ponds with three different levels of waterhyacinth cover; C (control), T1 (5% cover) and T2 (10% cover).

Values for pH were normally highest in control ponds (0 % cover) and lowest in ponds with 5 % and 10 % cover. Total mean of pH values ranged between 8.64 in T2 and 9.07 in control ponds (Table 1). There were significant differences ($P<0.05$) in pH among treatments. The pH values in all treatments were almost alkaline and ranged from 8.35 in December at 10 % cover (T2) to 9.21 in August at control treatment (Fig. 1). Differences in pH may be related to different rates of removal of carbon dioxide by phytoplankton during photosynthesis as evident from the positive relationship between pH and phytoplankton abundances as

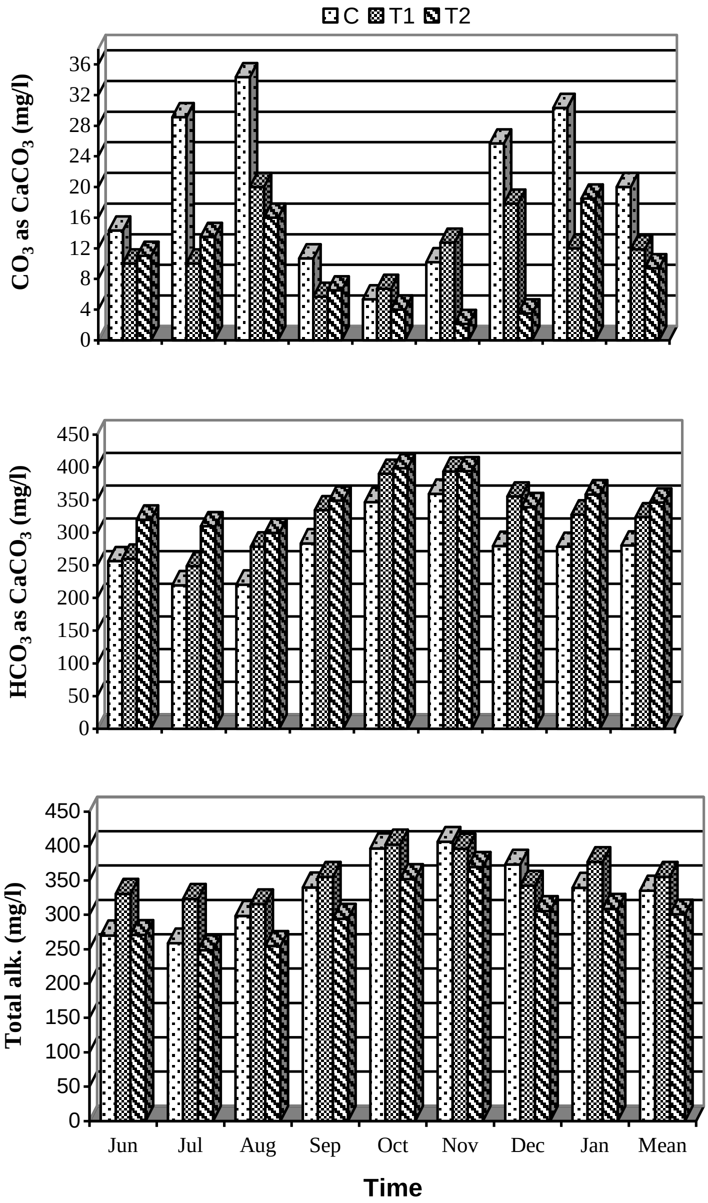

Figure 2: Monthly variations of water alkalinity (carbonate, bicarbonate and total alkalinity) in earthen ponds with three different levels of waterhyacinth cover; C (control), T1 (5% cover) and T2 (10% cover)

estimated by (McVea and Boyd, 1975; Henry-Silva and Camargo, 2008). Also, Balls et al. (1989) mentioned that aquatic plants serve as contributors of autochthonous organic carbon and impacting productivity in freshwater systems.

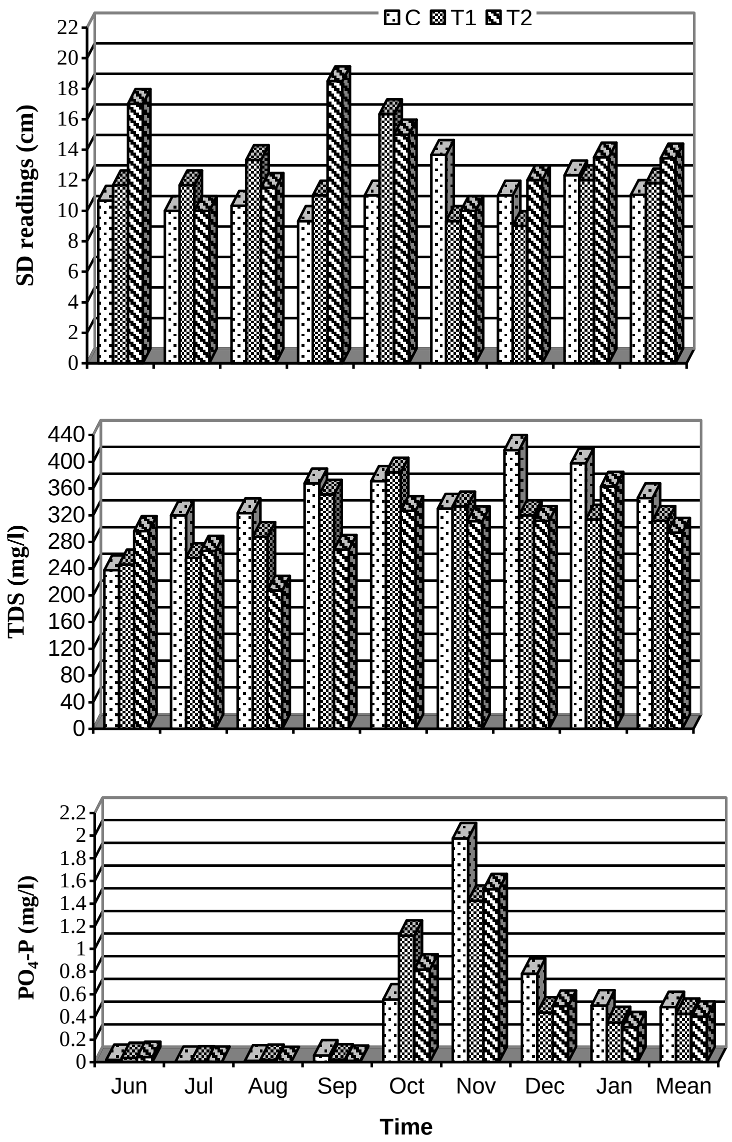

Figure 3: ***Monthly variations of water visibility, total dissolved salts and dissolved phosphate in earthen ponds with three different levels of waterhyacinth cover; C (control), T1 (5% cover) and T2 (10% cover)***

Dissolved oxygen was slightly higher in fish ponds cover with 5 % than those covered with 10 %, and the maximum value was recorded at control in June (10.67 mg l^{-1}), while the minimum one was recorded at 10% cover treatment in November (4.0 mg l^{-1}) (Table 1 & Fig. 1). The overall mean of dissolved oxygen levels ranged between 4.97 mg l^{-1} in T2 and 7.38 mg l^{-1} in control ponds and were significantly different ($P<0.05$) among treatments. The decrease of dissolved oxygen in ponds with 10 % cover may be related to the higher level of organic matter (died plants) in ponds which may have increased oxygen demand. Moreover, the high concentration of dissolved oxygen in control compared to T1 and T2 could be due to the high occurrence of phytoplankton, where phytoplankton produce 70% of oxygen in ecosystem (Reynolds, 1984). In this respect, Boyd and Tucker (1998) stated that, oxygen content due to photosynthetic activity is often recorded with abundant phytoplankton. Photosynthesis is limited beneath water hyacinth mats, and the plant itself does not release oxygen into the water as do phytoplankton and submerged vegetation (Meerhoff et al., 2003), resulting in decreased dissolved oxygen concentration. McVea and Boyd (1975) found that up to 25% cover of 0.04-ha experimental ponds did not cause dissolved oxygen to reach levels that threaten fish survival, although they did find an inverse negative relationship between dissolved oxygen and water hyacinth cover. Dissolved oxygen less than 5 mg l^{-1} are known to adversely affect function and survival of most fish, and less than 2 mg l^{-1} can lead to fish kills (Chapman, 1996). Generally, dissolved oxygen in this study was adequate for fish culture in the three treatments.

Concerning total alkalinity (carbonate and bicarbonate) there was a slight difference among the three treatments (Table 1 & Fig. 2). However, the mean values of carbonate decreased in T1 (11.87 mg l^{-1}) and T2 (9.39 mg l^{-1}) compared with control ponds (19.99 mg l^{-1}) (Table 1). The carbonate in control may be increased as a result of increased photosynthetic activities. Ferdoushi et al., (2008) reported a significant increase in carbonate alkalinity in control (without plants) than ponds contained aquatic macrophytes. Bicarbonate alkalinity had a reverse trend, as it increased in T2 than those in T1 and control and this may be related to decrease phytoplankton biomass and increase CO_2 from decomposition of died plants.

The minimum (9.0 cm) and maximum (18.5 cm) values of secchi disc readings were recorded in December and September at T1 and T2, respectively (Fig. 3). Water visibility as overall mean (Table 1) was higher in T2 (13.44 cm) than that in control (11.04 cm) and T1 (11.79 cm), which might have resulted from the dispersion of colloidal clay particles, and the suspended organic particles due to fish movement in ponds and the abundance of phytoplankton (Boyd and Tucker, 1998). Macrophytes are expected to increase water transparency by decreasing suspended particles, including phytoplankton. Water bodies with medium and dense macrophytes cover are characterized by a low concentration of suspended sediments, hence high water transparency (Villamagna, 2009). Where aquatic macrophytes disappear, such as under the impact of eutrophication, water transparency is reduced (Ferdoushi et al., 2008). The different treatments showed lowered SD reading as a result of resuspension of sediments by fish and wind.

Regarding, total dissolved salts (TDS), it was obviously higher in control ponds than those in covered ponds. It ranged from 207.0 mg l^{-1} at T2 treatment in August to 417.7 mg l^{-1} at control ponds in December (Fig. 3). There was a significant (P>0.05) variations in water TDS among treatments. The highest total mean (345.7 mg l^{-1}) was recorded at control, while the lowest (293.8 mg l^{-1}) one at T2 ponds (Table 1). The reduction in TDS values in T1 and T2 ponds revealed that waterhyacinth mat highly absorbed various salts from pond water.

Table 1 showed that overall mean of soluble orthophosphate concentration in pond water of control (0.49 mg l^{-1}), T1 (0.43 mg l^{-1}) and T2 (0.40 mg l^{-1}), differed but not significantly (P>0.05). The maximum value was recorded at control during November (1.98 mg l^{-1}), while the minimum (0.002 mg l^{-1}) one was recorded at T2 ponds in August (Fig. 3). It is clear that orthophosphate concentration was inversely correlated with plant cover and temperature indicating that waterhyacinth and phytoplankton absorb considerable amounts of this nutrient (McVea and Boyd 1975; Boyd and Tucker, 1998). Water hyacinth has the potential to significantly reduce nutrient concentrations in a water body depending on the extent of cover and density (Pinto-Coelho & Greco, 1999). The present results comply with Rommens *et al.* (2003) and Rodríguez-Gallego *et al*. (2004) who mentioned that nutrient uptake is thought to vary by season, with greater uptake in the summer when temperatures are higher and more favorable for plant growth. Increase of dissolved phosphorus in T1 and T2 after summer compared with control ponds could probably due to a return of phosphate to water through decomposition of dead plants of *E. crassipes*. Resuspension also simultaneously leads to the remobilization of phosphorus locked in the sediment, so more phosphorus is available for primary production in the three treatments.

Treatments showed change in total ammonia (NH_4 and NH_3) and nitrite concentrations over time for the 0, 5 and 10 % cover ponds (Table 1 & Fig. 4). Data indicated that there was a significant change ($P<0.05$) in ammonia content but not for nitrite with increasing percent cover over time. The higher ammonia and nitrite concentrations in ponds with 5 and 10 % cover may be due to a higher oxygen demand by nitrifying bacteria to oxidize organic material from plants that died (Sipaúba-Tavares et al., 1999). This suggests that the presence of phytoplankton and water hyacinths in the ponds contributes to the removal of nitrogenous compounds. Total ammonia and nitrite concentrations were always below toxic levels of all treatments during the study. Nitrate concentrations differed significantly ($P<0.05$) with treatments (Table 1). Levels of nitrate in ponds with 0 % cover (control) were considerably higher ($P<0.05$) than those in T1 and T2. This could be attributed to the increase in DO concentration as photosynthesis in this treatment was increased with high phytoplankton production.

The less variation in nutrients concentration among the studied ponds may result from that the water hyacinth covers not enough to cause great variation in nutrients content. However, nitrate and orthophosphate decrease in 5 and 10% cover than in unvegetated ponds (control). The inhibition of phytoplankton growth among dense macrophytes is likely related to competition for light and nutrients (Wetzel, 1983). Meerhoff et al. (2003) and McVea and Boyd (1975) suggesting that the impact of free-floating macrophytes on nutrients depends greatly on their biomass and cover.

Phytoplankton structure and biomass

Phytoplankton is a potentially functional aquatic community and it is the base upon which aquatic food chain is culminating (Reynolds 1984). Phytoplankton belonging to four classes was identified in the ponds namely; chlorophyceae, bacillariophyceae, cyanophyceae and euglenophyceae.

Estimates of phytoplankton abundance suggest, although values were normally greatest in control ponds, differences in values for different treatments were often not significant (Fig. 5). Concerning, phytoplankton variations in treatments the total mean number (18180.20 org./l) produced in ponds of T1 was markedly less than control (24996.54 org./l) and T2 (20922.51 org./l) ponds. Regarding monthly variations, the total phytoplankton numbers varied between 8672.25 and 33719.81 org./l in September and October, respectively in T1, while in T2 the numbers were ranged between 10156.99 and 32831.81 org./l in July and November, respectively. The maximum (34393.34 org./l) and minimum (10808.53 org./l) numbers were recorded in December and January at control, respectively.

Figure (6) showed the total mean number and percentage of different phytoplankton groups during the study. Chlorophyceae and bacillariophyceae were the most abundant groups ($P<0.05$) and represented the highest number (28567 and 22215 org./l) and percentage

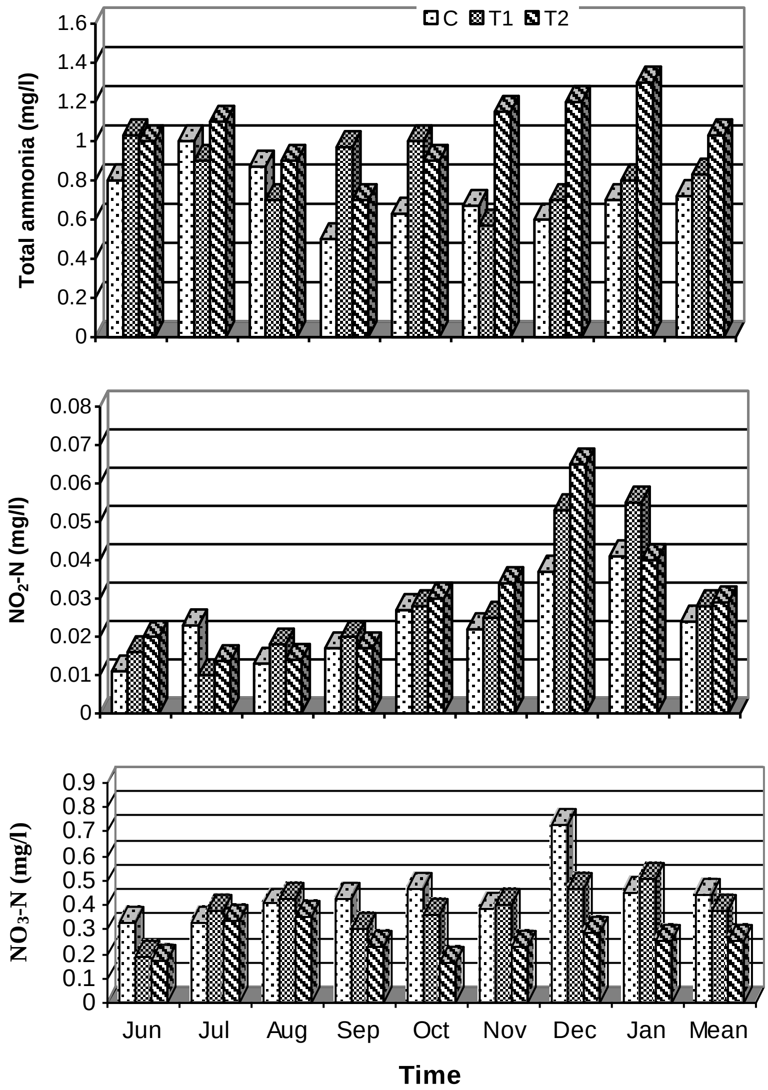

Figure 4*: Monthly variations of water dissolved inorganic nitrogen (total ammonia, nitrite and nitrate) in earthen ponds with three different levels of waterhyacinth cover; C (control), T1 (5% cover) and T2 (10% cover).*

(44 and 35%), respectively. On the other hand, cyanophyceae (9546 org./l; 15%) and euglenophyceae (3628 org./l; 6%) were the less abundant ones in all treatments. These results are quite similar to those found in studies on Abbassa ponds (Ahmad *et al*., 2001 and Abdel-Tawwab, 2011). They proposed that chlorophyceae and bacillariophyceae represented the major species, whereas cyanophyceae and euglenophyceae represented the minor ones in earthen fish ponds.

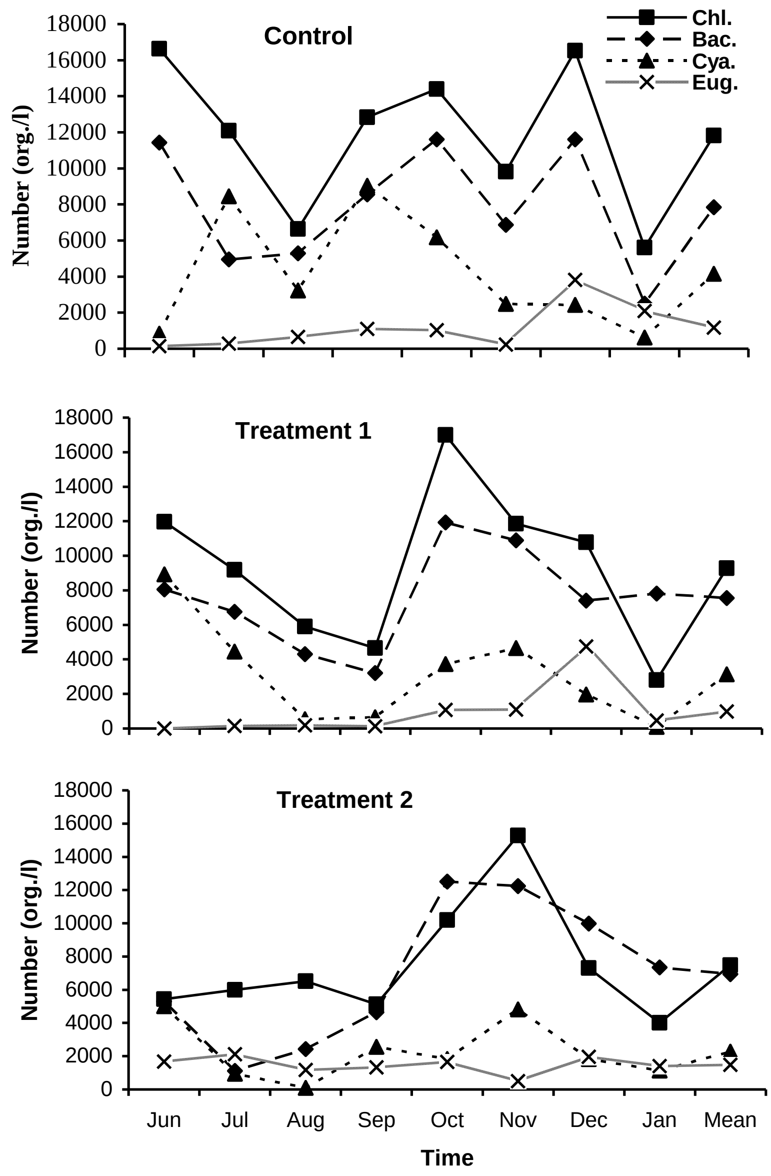

Figure 5: ***Monthly variations of major phytoplankton groups (org./l) in earthen ponds with three different levels of waterhyacinth cover; C (control), T1 (5% cover) and T2 (10% cover).***

The aquatic macrophytes applied in ponds of treatments 1 and 2 acted as a biofilter, so the nutrient concentrations remained in a suitable range in these ponds. Aquatic macrophyte *E. crassipes* is most effective in reducing chlorophyll-*a* concentration (phytoplankton biomass) and nutrients (Crispim et al., 2009). Gupta and Dey (2013) observed

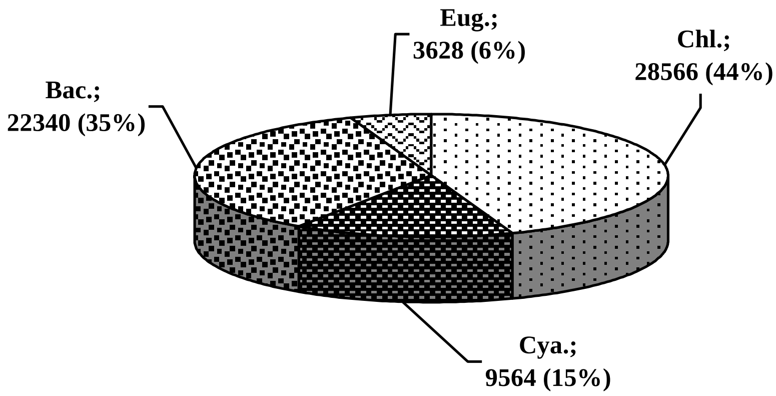

Figure 6: ***Total mean number and percentage of different major phytoplankton groups (org./l) in earthen ponds during the experimental period.***

that, heavy growth of macrophytes led to decrease the phytoplankton numbers in fish ponds. The control and T1 ponds exhibited high number of phytoplankton organisms in comparison to that of T2. This result might be due to the availability of nutrients (especially phosphorus) required for phytoplankton flourishing. These results are similar to that indicated by McVea and Boyd (1975) and Velasco and Cortes (1994) who found significant reduction of chlorophyll *a* content with increase of the coverage level of water hyacinth in fish ponds. Sharma et al. (1996) and Meerhoff et al. (2003) found that water hyacinth cover could inhibit phytoplankton growth.

Rommens et al. (2003) found lower levels of phytoplankton productivity, phosphate, oxygen, pH and nitrate at sites vegetated with hyacinth than those in the unvegetated ones. In this study, control treatment had higher levels of nutrients (N and P) and this related to increase phytoplankton production. So, there was a positive correlation between concentration of these nutrients and phytoplankton density. This relationship suggests that removal of nitrate and orthophosphate by waterhyacinth in T1 and T2 deprived, to some extent, phytoplankton from these nutrients as well as sunlight and adversely affected their growth.

Fish Production

Production of *Tilapia niloticus* was not reduced appreciably by plant cover with waterhyacinth. Fish net production did not significantly change ($P>0.05$) with increasing plant cover (Fig. 7). The ponds with 5 % cover and control had the highest fish production 2160.2 and 2071.9 kg/fed, respectively. The improved water quality condition found in these ponds originate by the higher dissolved oxygen concentrations and lowest total ammonia and nitrite concentrations, was probably the cause for the larger size fish and production in these ponds. McVea and Boyd (1975) mentioned that maintaining stable phytoplankton populations and low total ammonia and nitrite concentrations improved water quality which translated into larger fish production.

Differences in fish production not exhibited the same general relationship to treatment as did phytoplankton production. Other workers have demonstrated a direct relationship between phytoplankton production and the production of fish. McVea and Boyd

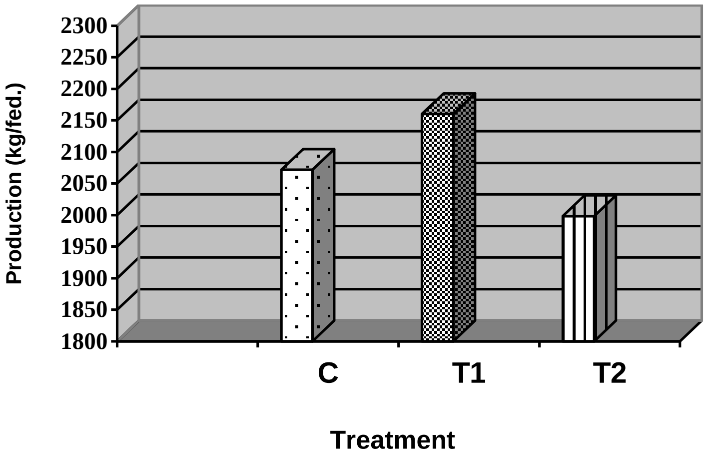

Figure 7: ***Average net production of fish, Oreochromis niloticus, in earthen ponds with three different levels of waterhyacinth cover; C (control), T1 (5% cover) and T2 (10% cover).***

(1975) tested the effects of water hyacinth on production of *Tilapia aurea* feed mainly on natural organisms (phytoplankton). They found that fish production was not affected by 5% water hyacinth cover, but 10 and 25% cover reduced production. In these cases, water hyacinth cover was indirectly affecting fish productivity via decreases in phytoplankton production with increased cover. Many investigators suggest that moderate levels (10 to 40 percent coverage) of plant density are optimal for fish production, commercial fishing, and for stabilizing water quality in freshwater systems (Hestand and Carter 1978 and Wiley et al. 1984).

Vegetation in aquatic systems impacts growth and condition in fish. According to (Killgore et al., 1993) moderate plant densities and plant edges, if maintained, should increase the growth and condition of harvestable fish and supply enough food and cover for the strong recruitment and survival of younger fish. In this study, Nile tilapia fed primarily on artificial feed. The optimum fish growth could be obtained when supplemental feed was given to fish. Therefore, waterhycinth not affected fish production through competition with phytoplankton.

CONCLUSION

The free floating aquatic plant water hyacinth (*Eichhornia crassipes*) has demonstrated a slight effect on the water quality in ponds receiving dry feeds when allowed between 5 and 10 % of the pond surface area. The results showed that the introduction of floating aquatic macrophytes in ponds of treatments 1 and 2 reduce the nutrients (N and P) loading and phytoplankton biomass in the aquatic environment. There were no changes in the species composition of phytoplankton induced by water hyacinth. Also, this percent of plant cover did not significantly affect fish production in earthen ponds.

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تأثير نبات ورد النيل على الخواص الفيزيائية والكيميائية للمياه، الكتلة الحيوية للعوالق النباتية وإنتاج أسماك البلطي النيلى في الأحواض الترابية

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أجريت هذه الدراسة فى الفترة من يونيو ٢٠١٢- يناير ٢٠١٣ بالمعمل المركزى لبحوث الثروة السمكية بالعباسة لمعرفة مدى تأثير نسب مختلفة من الغطاء النباتى لنبات ورد النيل على الخواص الفيزيائية والكيميائية للمياه، كثافة العوالق الحية النباتية (والتى تعتبر الغذاء الطبيعى للأسماك) وإنتاج أسماك البلطي النيلى في الأحواض الترابية. وقد أوضحت النتائج أن غطاء ورد النيل له تأثير على بعض خصائص المياه حيث قل تركيز قياسات درجة الأس الهيدروجينى، الأملاح الكلية الذائبة، الأكسجين الذائب، الفوسفور الذائب، القلوية فى صورة الكربونات، النترات بينما سجلت قراءات أعلى من الأمونيا الكلية والقلوية الكلية فى معاملات الغطاء النباتى عن الكنترول (بدون ورد النيل) ولكنها فى حدود المسموح به للإستزراع السمكى. قياسات درجة الأس الهيدروجينى، الأكسجين الذائب، القلوية فى صورة الكربونات والنترات سجلت فروق ذات دلالة معنوية كما لم تسجل قياسات (الحرارة، شفافية المياه، الأملاح الذائبة الكلية للمياه، الأمونيا الكلية، النتريت، القلوية الكلية والفوسفور الذائب) آية فروق ذات دلالة معنوية. أظهرت العوالق الحية النباتية الفيتوبلانكتون مستويات أعلى فى مياه معاملة الكنترول (بدون ورد النيل) ولم يختلف تركيب الهائمات النباتية من معاملة إلى أخرى ومعظم هذه الهائمات يتكون من الطحالب الخضراء (٤٤%) وبنسبة أقل من الدياتومات (٣٥%) أما الطحالب الخضراء المزرقة ففى المرتبة الثالثة (١٥ %) أما اليوجلينا فهى ممثلة بنسبة أقل (٦ %) من العدد الكلى. أوضحت الدراسة أيضا زيادة الإنتاج السمكى فى معاملتى الكنترول (غطاء نباتى صفر %) والمعاملة T1 (غطاء نباتى ٥%) عن المعاملة T2 (غطاء نباتى ١٠ %) مع عدم وجود آية فروق ذات دلالة معنوية بين المعاملات الثلاث وذلك لإعتماد الأسماك على العلف الصناعى كغذاء أساسى بالإضافة إلى العوالق النباتية. بإعتبار النسب المستخدمة فى هذه الدراسة فإن غطاء ورد النيل ليس له تـأثير ذو دلالة على الإنتاج السمكى.